Banagrass-for-Energy Scale-up Trial

C.M. Kinoshita*[a], S.Q. Turn [a], L.A. Jakeway[b,c], R.V. Osgood[b], and N.S. Dudley[b]
[a]Hawaii Natural Energy Institute and Biosystems Engineering, University of Hawaii
2540 Dole Street, Holmes 246 Honolulu, Hawaii 96822
Fax: (808)956-2335; kinoshi@wiliki.eng.hawaii.edu
[b]Hawaii Agriculture Research Center; [c]Presently at Hawaiian Commercial and Sugar Company

With favorable growing conditions throughout the year, Hawaii is well-suited for crops grown specifically for conversion into more usable forms of energy such as electricity or transportation fuels. Of the many species being considered as potential commercial energy crops, banagrass, a cultivar of elephantgrass (*Pennisetum purpureum*), appears to be most suitable for tropical areas such as Hawaii from the standpoints of yield and cost.

In the last decade, the Hawaii Agriculture Research Center (HARC, formerly, the Hawaiian Sugar Planters' Association) installed several field trials to evaluate the potential for banagrass as an energy crop. One series of small plot trials investigated planted and ratoon (i.e., the regrowth following harvesting) banagrass crops at five different sugarcane plantations on four islands in the state of Hawaii. A subsequent field trial tracked a single 0.3-ha banagrass plot in Hoolehua, Molokai, through a planted crop and six ratoons. The two trial series demonstrated that (1) high yields of banagrass are achievable; (2) ratoon crops outyield planted crops; (3) banagrass crops grown during the summer outyield crops grown during the winter. To validate the findings described above and to ascertain yield and cost information needed for evaluating the feasibility of producing banagrass as a commercial energy crop, HARC and the Hawaii Natural Energy Institute of the University of Hawaii, installed a larger, 4.6-ha banagrass trial at the Hoolehua site. In the scale-up trial, the planted and ratoon crops were maintained and processed in a manner similar to that anticipated for commercial operations.

The planted crop in the 4.6-ha trial had a dry-matter yield of 37.4 T/ha at 7.7 months, translating to an annualized yield of 58.5 T/ha-y, and the ratoon crop had a yield of 44.6 T/ha at 8.0 months, translating to an annualized yield of 67.4 T/ha-y (Table 1). The planted crop was harvested and transported from the field using equipment commonly employed in commercial sugarcane production (Fig. 1). The information gained in the scale-up trial was used to evaluate the likely costs of planted and ratoon crops in commercial banagrass-for-energy production in Hawaii.

Table 1. Summary of banagrass yields in planted and ratoon crop plots.

	Planted Crop	Ratoon Crop
Age at harvest (months)	7.7	8.0
Moisture content (%)	71.6	64.2
Crop yield, fresh weight (T/ha)[a]	130	125
Annualized yield, fresh weight (T/ha-y)	204	188
Crop yield, dry matter (T/ha)	37.4	44.6
Annualized yield, dry matter (T/ha-y)	58.5	67.4

[a] Yield data obtained from 12 hand-harvested plots, each 2 rows wide x 6 m long.

Fig. 1. Harvesting of planted banagrass crop using sugarcane harvester and transferring chopped banagrass into tipper trailer for infield transporting/transloading.

The following were learned from the scale-up field trial and cost analysis:

1. High yields of banagrass can be obtained on a commercial basis. The ratoon crop, which is much less costly to produce than the planted crop, significantly out-yields the planted crop.
2. The planted and ratoon crops in the large trial were irrigated and fertilized at levels high enough to ensure that neither became significant yield-limiting factors. Because both irrigation and fertilization are significant components in the overall cost of producing banagrass, additional research is needed to optimize the irrigation and fertilization regimes and thereby reduce the overall cost of producing banagrass.
3. Harvesting and transporting banagrass are among the costliest unit operations in banagrass production. Commercial sugarcane harvesting and transporting equipment such as those used in this trial show promise, but need to be optimized for banagrass to reduce the unit cost of banagrass delivered at the conversion facility.
4. Major areas for improvement in banagrass harvest and transport operations include higher productivity (hectares or tonnes harvested per hour), increased recovery (reducing dry-matter loss), and increased bulk density in the harvested material. Self-propelled forage harvesters may be more productive and cost effective than the type of sugarcane harvesting equipment used in this trial.